

## Science teacher pedagogy

Having looked at the influence of the curriculum and the assessment system on science teachers, we turn now to look at science teacher pedagogy itself – the dependent variable. By pedagogy we mean more than teaching. Pedagogy implies the whole philosophy and value system that leads teachers to make the choices they do in what and how to teach. Shymansky et al. writing about their research in Australia describe a 'typical' classroom and science teacher:

The classroom was a self-contained lecture-laboratory room. The teacher, a middle-aged man with a strong academic background in physical science, was an active graduate student pursuing a masters degree in science education at a local university. He expressed commitment to many constructivist ideas. He was enthusiastic about implementing ideas that he had researched at the university, and valued hands-on/minds-on activities, collaborative problem solving, and communities of learning. However, to some extent he was restricted in his teaching values and intentions by the need to complete the requisite subject matter of the unit of study within an allotted period of time. Nevertheless, within the traditional structure of the science department in his school, his lessons included strategies and activities that promoted knowledge construction and discourse opportunities. He used whole-class discussion for organization of the day's activities, and students frequently worked in small groups to complete experiments, reports, and study guides.

(1997, p. 576)

Although nowadays the 'typical' science teacher might (a) be female and (b) not be studying for a conventional masters degree, and, therefore, would be less aware of the discourse of 'constructivism', there are many characteristics of the description above that would typify a secondary school science lesson in England and many other countries. The crux of the debate about science teachers' pedagogical development relates to the perceived need for teachers to challenge the orthodox 'teaching values and intentions' which manifest themselves in what many would describe as 'traditional science teaching'.

For many teachers, compulsory investigatory work 'by Order' (Donnelly et al., 1996) created the greatest need for a shift in science teacher pedagogy. Teachers had to organize and assess a minimum of investigations (around one or two each term). Although Nuffield Science and later curriculum material

attempted to challenge the existing orthodoxy of practical work, the majority of experimental work carried out in schools tended to be confirmatory rather than investigational (Donnelly et al., 1996). However, despite the approach inherent in the National Curriculum documents, commentators (for example, Jenkins, 1992) have argued that little real progress has been made in that school science is not radically different from what went on before the changes. Millar and Osborne, for example, described the science curriculum as being 'a diluted [that is, similar topics but easier] form of the GCE curriculum' (1998, p. 2004). They argued that that the curriculum content was very similar to the O-level courses that preceded the GCSE, which were generally very traditional in their approach and which encouraged traditional science teaching.

Dillon and Osborne (1999, p. 1) argued that there were 'a number of widespread concerns about the capabilities of the extant [science] teaching force to deliver an exciting and engaging experience [to pupils]'. These concerns focused on problems with the recruitment and retention of science teachers (see also Chapter 13). Other issues have also been of concern, for example, the Council for Science and Technology (CST) noted in 2000 that 'a significant number of pupils are negative about the intrinsic and extrinsic merits of science and/or the science curriculum' (CST, 2000, p. 10). This negativity is, in part, a reflection of the ways in which science is taught in schools (Osborne and Collins, 2000).

Keys, reporting on the findings of the Second International Science Study (1982–86), wrote that:

While the majority of 14 year-olds reported that their teachers normally introduced new material and went over material which had been covered previously at the beginning of each lesson, rather fewer reported that their science teachers summarized what had been taught at the end of each lesson... About half the 14 year-olds reported copying from the blackboard often and half doing so sometimes... Over 90 per cent of the 14 year-olds reported having science tests, about 40 per cent often and 50 per cent sometimes.

(1987, p. 159)

Thus there is little evidence that science teaching, in terms of strategies and tactics, made significant progress during the period from the 1970s to the 1990s when many of today's science teachers were themselves school students. This state of affairs occurred despite the best endeavours of new curricula and new resources which encouraged aspirations of more creative processes that, in the end, were rarely met.